Review Paper:

The Therapeutic Effects of Bioactive Compounds in Honeybee Products

Sepideh Hesami[1,2], ***Hossein Khadem Haghighian**[1,2]

1. Department of Public Health in Nutrition, School of Health, Qazvin University of Medical Sciences, Qazvin, Iran.
2. Metabolic Diseases Research Center, Qazvin University of Medical Sciences, Qazvin, Iran.

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ABSTRACT

Honey, royal jelly, propolis, and bee pollen are potentially beneficial to humans due to their bioactive agents. Different molecules of these honeybee products have been extracted and pharmacologically characterized. Phenolic acid, Major Royal Jelly Proteins (MRJPs), and oligosaccharides are major bioactive substances of these products. Propolis, especially Brazilian type, contains caffeic acid phenethyl ester and artepillin C, with immunomodulatory, anti-inflammatory, and anticarcinogenic effects. Bee pollen has antioxidant and anti-inflammatory properties due to vitamins and plant phenols. Additionally, flavonoids, unsaturated fatty acids, and sterols contribute in antiatherosclerotic, antidiabetic, and hypoglycemic properties of bee pollen. In the royal jelly, there are MRJPs and hydroxy-decenoic acid derivatives, especially 10-Hydroxy-2-Decanoic Acid (10-HDA). This review study was conducted in 2016-2017 with the aim of investigating the therapeutic effects of honeybee products by searching the databases of PubMed, Scopus, ScienceDirect, IranMedex and Google Scholar using the keywords “honey, propolis, royal jelly, bee pollen, anti-inflammatory, and antioxidant". In this study, we observed that the anti-inflammatory activity, immunomodulation, nerve regulation, and the prevention of metabolic syndrome are attributed to these factors. Given the importance of discovering and access to herbal medicines, this review provided a comprehensive overview of the bioactive compounds detected in the honeybee products as well as the therapeutic effects and biological side effects of them.

Extended Abstract

1. Introduction

Honey is the main product of bees, derived from the digestive process of making nectar from flowers, stored in honeycomb cells. In general, honey is marketed due to its nutrition. In the past, it was used as a local treatment; while, it has been introduced as an auxiliary medicine in the recent years [4].

It is composed of at least 181 components and is basically a solution supersaturated in sugars. Fructose (38%) and glucose (31%) are the most important components of it. The moisture content consists about 17.7% of it, total acidity 0.08%, and ashes constitute 0.18% of honey. In addition, it contains a great variety of minor components, including phenolic acids and flavonoids, glucose oxidase and cata-

Corresponding Author:
Hossein Khadem Haghighian, PhD.
Address: Department of Public Health in Nutrition, School of Health, Qazvin University of Medical Sciences, Qazvin, Iran.
Tel: +98 (914) 8375283
E-Mail: khademnut@yahoo.com

lase, ascorbic acid, carotenoids, organic acids, amino acids, proteins, and α-tocopherol [15]. The actual composition of honey varies, depending on many factors such as the pollen source, climate, environmental conditions, and the processing it undergoes [33].

Honey is a natural substance with many medicinal effects such as antibacterial, hepatoprotective, hypoglycemic, reproductive, antihypertensive and antioxidant properties. This review study presents findings that indicate honey may ameliorate oxidative stress in the Gastrointestinal Tract (GIT), liver, pancreas, kidney, reproductive organs and plasma/serum [47]. Furthermore, this review highlights data that demonstrate the synergistic antioxidant effect of honey and antidiabetic drugs in the pancreas, kidney, and the serum of diabetic rats. These data suggest that honey, administered alone or in combination with conventional therapy, might be a novel antioxidant in the management of chronic diseases commonly associated with oxidative stress. In view of the fact that the majority of these data emanate from animal studies, there is an urgent need to investigate this antioxidant effect of honey in human subjects with chronic or degenerative diseases [34].

The recognized pharmaceutical properties of the compounds and molecules extracted from the honeycomb products emphasize the importance of honey products in the discovery of herbal medicines. Considering the importance of this field of research in modern medications on suspected diseases, this study aimed to provide a comprehensive overview of the bioactive compounds known in the products of the crop and the effects of curative or biological complications.

2. Methods and Materials

This review study was conducted in 2016-2017 by searching the databases of PubMed, Scopus, ScienceDirect, IranMedex and Google Scholar using the keywords "Honey, Propolis, Royal Jelly, Pollen, Anti-inflammatory, Antioxidant." We investigated the therapeutic effects of bee products. Articles presented in conferences, theses, and the abstracts of articles were excluded. In the initial search, 113 articles were screened, and 22 articles were reviewed and criticized by removing duplicate articles or those without full text access.

3. Results

Honey is produced by bees collecting the nectar of flowers and through repeated digestion and vomiting. Acidic pH of the stomach, together with the enzymatic activity of amylase, diastase, and invertase, result in the formation of an over saturated aqueous solution of 80% sugar, mainly fructose and glucose, with the minor amounts of sucrose, maltose and other complex sugars [22]. Organic acids, in particular, gluconic acid, are created by the activity of glucose oxidase and acidic acid. The average pH of honey is 3.9. Additionally, vitamins, especially vitamin B family, are induced by pollen grains, and ascorbic acid is low in honey. The amount of minerals in honey varies from 0.2 to 0.4, which reflects the number of soil minerals in honey nectar plants. Approximately one-third of honey is consisted of potassium [19].

The flavonoid content of Italian honey extract (containing flavonoids, epinephrine, genistein, luteolin, kaempferol, and quercetin, as the main components) inhibits the release of proinflammatory agents such as TNFα and IL-1β from LPS-stimulated N13 microglial cells. Referring to the role of neuronal inflammation in neurodegenerative diseases, the use of honey flavonoids may have the potential to cope with diseases such as Alzheimer's and Parkinson's [13].

Phenols are the most important antioxidant capacity elements of honey, and the phenol composition is very different from plant sources. Honey is expected to exhibit a wide range of antioxidant activity. In a study with 13 samples of honey collected from 9 different species of bee, 26 phenolic compounds were extracted from honey. Salicylic acid, pacomaric acid, naringenin, and taxophilic were extracted from its major phenolic compounds. In addition, caffeic acid and rosemary acid were first observed in honey samples [62].

The effects of honey on controlling various cancer types have been studied in animal and laboratory models. Polyphenols have protective properties against various chemicals, and on the basis of more phenolic honey, they are more potent in preventing the proliferation of cancer [10].

4. Conclusion

The pharmaceutical and clinical use of honeycomb products are increasing. Clinical research studies have been conducted on the effects of honey on wound healing and diabetes, the effect of royal jelly on diabetes and rheumatoid arthritis, and the impact of an overdose on disinfection and gingivitis. Due to the complexity and diversity of these compounds, standardization is necessary before the clinical predictions of its safety and efficacy [15]. The therapeutic use of certain compounds of honeycomb products remains unapproved.

In this review study, some compounds and their effects on biochemical pathways, cells, organs, and their potential use as medications were presented. In addition, based on clinical studies, some of the factors present in these prod-

ucts are likely to be MRJP, 10-HDA, CAPE, arthylpin-C, malathion, and atomic analogues of standard medications. However, none of those has been reported in the clinical database records, with the exception of CAPE2, which is not used as a specific medication [3]. There are different reasons to explain the gap between the clinical exploitation of honeycomb products and their constituents, including the toxicity of biologically active agent.

Ethical Considerations

Compliance with ethical guidelines

There was no ethical considerations to be considered in this research.

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Authors contributions

All authors contributed in designing, running, and writing all parts of the research.

Conflict of interest

The authors declared no conflict of interest.

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مروری بر اثرات درمانی مواد زیست‌فعال در محصولات زنبوری

سپیده حسامی[۱،۲]، * حسین خادم حقیقیان[۱،۲]

۱- گروه علوم بهداشتی در تغذیه، دانشکده بهداشت، دانشگاه علوم پزشکی و خدمات بهداشتی‌درمانی قزوین، قزوین، ایران.
۲- مرکز تحقیقات بیماری‌های متابولیک، دانشگاه علوم پزشکی و خدمات بهداشتی‌درمانی قزوین، قزوین، ایران.

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چکیده

عسل، ژل رویال، برمموم و گرده زنبور عسل به دلیل داشتن مواد زیست‌فعال بالقوه برای انسان‌ها سودمند هستند و مولکول‌های مختلفی از آن‌ها استخراج و از لحاظ دارویی مشخص شده‌اند. فنولیک اسید، پروتئین‌های ژل رویال (MRJP) و الیگوساکاریدها، عمده مواد زیست‌فعال این محصولات هستند. برمموم متشکل از کافئیک اسید فنتیل استر و آرتپیلین-C، به‌ویژه در نوع برزیلی است که اثرات تعدیل ایمنی، ضدالتهابی، و ضدسرطانی دارد. گرده زنبور عسل به دلیل ماهیت ویتامینی و فنولیک‌های گیاهی خواص آنتی‌اکسیدانی و ضدالتهابی دارد. همچنین فلاونوئیدها، اسیدهای‌چرب غیراشباع و استرول‌ها به گرده زنبور عسل خواص ضدآترواسکلروز، ضددیابت و کاهنده قندخون می‌بخشند. در ژل رویال، پروتئین‌های ژل رویال، مشتقات هیدروکسی دکانوئیک اسید به‌ویژه ۱۰-هیدروکسی-۲-دکانوئیک اسید (10-HDA) وجود دارد. این مطالعه مروری در سال‌های ۲۰۱۶ و ۲۰۱۷ با جست‌وجو در پایگاه‌های اطلاعاتی ساینس ایندکس، اسکوپوس، پابمد، ایران مدکس، گوگل اسکالر و با استفاده از کلیدواژه‌های عسل، برمموم، ژل رویال، گرده زنبور عسل، ضدالتهاب و آنتی‌اکسیدان با هدف بررسی اثرات درمانی محصولات زنبور انجام شد. در جست‌وجوی اولیه ۱۱۳ مقاله یافت شد که درنهایت ۲۲ مقاله بررسی و نقد شد. در این مطالعه مشاهده شد عملکردهای ضدالتهابی، تعدیل ایمنی، تنظیم عصبی و پیشگیری از سندرم متابولیک را به عوامل زیست فعال عسل نسبت می‌دهند. با توجه به اهمیت کشف و دسترسی به داروهایی با منشأ گیاهی، این بررسی مروری ارائه جامعی از ترکیبات زیست‌فعال تشخیص‌داده‌شده در محصولات زنبوری و اثرات درمانی و اثرات جانبی بیولوژیکی آن‌ها خواهد داشت.

کلیدواژه‌ها:
عسل، برمموم، ژل رویال، گرده زنبور عسل

* **نویسنده مسئول:**
دکتر حسین خادم حقیقیان
نشانی: قزوین، دانشگاه علوم پزشکی و خدمات بهداشتی‌درمانی قزوین، دانشکده بهداشت، گروه علوم بهداشتی در تغذیه.
تلفن: ۸۳۷۵۲۸۳ (۹۱۴) ۹۸+
رایانامه: khademnut@yahoo.com